

## Section of Orthopaedics

President H E Harding FRCS

Meeting December 1 1964

### Short Papers

#### Fallacies in the Interpretation of Radiographs during Nailing of the Neck of the Femur

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Radiography as an essential aid to the nailing of a fracture of the neck of the femur is almost universal. Since the introduction of the cannulated trifin nail, the basic technique has been standardized to a great extent. The fracture is reduced by a combination of manipulation and traction; the limb is then secured to the orthopaedic table extension in a position of moderate abduction of the hip with medial rotation; traction is maintained.

The next and most important stage is the correct arrangement of the X-ray apparatus, since it is axiomatic that success or failure is largely dependent upon securing good radiographs. The usual practice is to obtain radiographs of the hip in two planes at right angles: the antero-posterior projection is obtained by placing one X-ray tube vertically with the film behind the hip; the lateral projection is produced by a horizontal tube so placed that the X-ray beam meets the long axis of the femoral neck at approximately a right angle. Preliminary radiographs are taken in two planes in order to confirm the accurate reduction of the fracture and to display markers if any visual aid is used to facilitate the insertion of the guide wire. The guide wire is introduced through the outer femoral cortex below the great trochanter in such a plane that it lies fairly close to the *calcar femorale* and transfixes the capital fragment centrally. Further radiographs are taken to confirm the correct position of the guide wire and to enable the surgeon to assess the length of nail required.

One assumption widely made is that if the tip of the guide wire is seen to be wholly contained within the confines of the femoral head in both

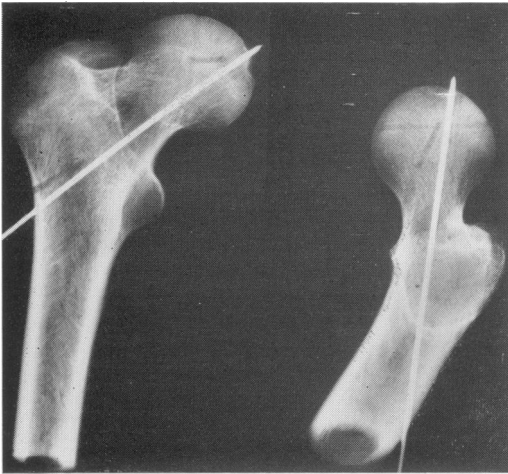
radiographs, then this must be its true position. For some time I have suspected that this was not always true, that in fact it was possible for the point of the guide wire to have passed through the head of the femur and to be projecting into the joint, though the radiographs indicated that it was still entirely within the head. In order to prove or disprove this theory the following experiment was performed.

#### Experiment

The upper end of the femur was obtained from a cadaver and a guide wire was introduced in a position suitable for the insertion of a trifin nail. The point was allowed to project through the articular cartilage by 0.5 cm. The specimen was then clamped in a position of moderate abduction, with the femur medially rotated 20 degrees. The X-ray tubes were arranged as previously described: a vertical tube with the film behind the femur and a horizontal tube so positioned that its beam met the inferior surface of the femoral neck at an angle of 100 degrees. Radiographs



Fig 1 Standard radiographs showing guide wire point entirely within the femoral head



**Fig 2** *Specially positioned radiographs displaying the true position of the guide wire*

were then taken and it can be seen that the point of the guide wire appears to be wholly within the femoral head (Fig 1). These standard radiographs give a false impression of the position of the point of the guide wire since we know that it is about 1 cm beyond the position indicated.

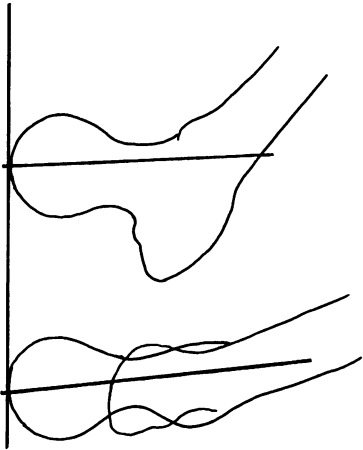
In order to get radiographs which indicate the true position it is necessary to place the hip so that the guide wire is directed towards the 'horizon' of the femoral head with respect to the X-ray beam. The true antero-posterior projection was obtained by externally rotating the hip 35 degrees until it was in 15 degrees of external rotation. The lateral projection was correct when the hip was adducted so that the 'tube-neck-angle' was reduced to 60 degrees (Fig 2).

### *Explanation*

It is necessary to explain this apparent paradox: any point within a three-dimensional space can be precisely located by reference to its position on the three Cartesian co-ordinates; these are axes at right angles to one another: one vertical and two horizontal. Now it would appear that the radiographs taken in two planes at right angles should provide all the necessary measurements to locate precisely the point of the guide wire. Because of the spherical shape of the femoral head, however, the radiographs are liable to give spurious information. In fact they will only give the true details under special conditions; i.e. when the guide wire is directed to the horizon of the head of the femur.

Fig 3 is a diagram representing the position of the X-ray beam, the hip and the corresponding radiograph during the taking of a lateral projec-

### **x-ray beam**

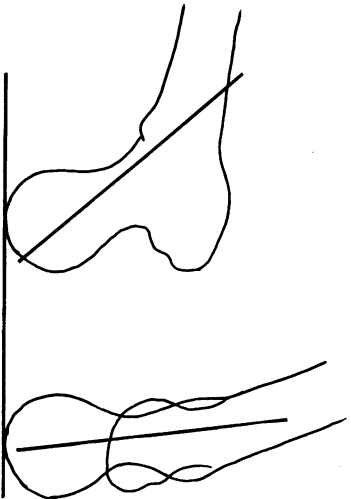


### **radiograph**

**Fig 3** *Representation of X-ray beam, femur, and radiograph when the guide wire is directed to the 'horizon'.*

*In Figs 3, 4 and 5 the upper drawing represents the guide wire in the femur, the lower drawing the appearance in the resulting radiograph*

tion film. The X-ray beam strikes the periphery of the head at a tangent at the point where the shadow will be cast. This I have called the horizon. Provided that the guide wire is directed towards this point, its shadow and that of the femoral head will accurately reflect their true relation. If the guide wire is directed in front or behind this point then the femoral head shadow will overlap that of the guide wire and a false picture will be obtained (Fig 4).



**Fig 4** *Representation of X-ray beam, femur, and radiograph when the guide wire is behind the 'horizon'*

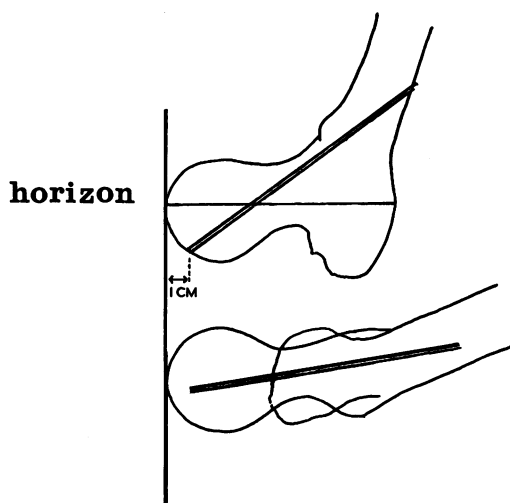


Fig 5 The guide wire deviates from the 'horizon' by about 40 degrees, so there is foreshortening of its shadow in the lateral radiograph of about 1 cm

The practical implications of this are of some importance: it has been shown that the guide wire may have penetrated a distance of up to 1 cm beyond the position indicated by radiography. It is important to avoid the nail penetrating the articular surface of the femoral head. Not only will the joint surfaces be damaged but a painful hip may result, particularly once weight-bearing is permitted. The one puzzling feature is that some patients in whom one is aware that the tip of the nail projects into the joint are nevertheless free from pain.

Perhaps more important, though less common, are cases of slipping of the upper femoral epiphysis: it is the usual practice to secure the epiphysis by introducing several pins somewhat obliquely so as to grip the relatively small epiphysis in several separate areas. In these circumstances the chances of one or more pins being at some distance from the horizon in both planes is increased and the chance of the articular cartilage being breached is correspondingly greater. To avoid these complications it is necessary to assess the plane of the guide wire in relation to the horizon – particularly the lateral radiograph. Fig 5 shows a guide wire inserted at a steep angle. The angle of deviation between the guide wire and the horizon is about 40 degrees and the amount of pseudo-shortening is approximately one centimetre. This should be added to the apparent length of the guide wire in the lateral projection to obtain its true position. Angles of less than 15 degrees can be ignored as the distance concerned would be too small to be significant.

*Acknowledgments:* I am very grateful to Dr F R Berridge, Addenbrookes Hospital, for his great kindness and help in the preparation of the cine-radiographic film which was used to illustrate the effect of the position of the hip upon the radiographic position of the guide wire. I wish to thank Sister O Walker and her staff in the X-ray Department at Bedford General Hospital for the radiographs of the specimen.

## Anterior Fusion of the Lumbar Spine: A Review of Twenty-four Patients

by M A Nelson FRCS  
(Guy's Hospital, London)

This paper reviews the results of anterior interbody fusion in patients with backache due to chronic disc degeneration, spondylolisthesis and intervertebral joint instability.

Most conventional methods of fusing the spine utilize the posterior approach. This technique gives a good view of the dura and nerve roots and allows adequate removal of a disc prolapse. Access to the disc space itself, however, is poor and fusion is usually attempted by placing grafts between the spines, laminae or transverse processes.

Atkins (1955) reviewed the results of fusion of the posterior elements and suggested that the claimed fusion rates of 70–80% were far too optimistic. He abandoned posterior intercorporeal fusion because of the high rate of failure in his hands, claiming that there was some intrinsic factor peculiar to the bone of the vertebral bodies which prevented bridging of the disc space by bone.

In 1948 Lane & Moore approached the intervertebral space from in front using a transperitoneal technique. They recorded their experience of 36 patients who had undergone interbody fusion, noted the good exposure and mentioned the theoretical advantage of compression obtainable between the vertebral bodies. Their follow up was short and no conclusions could be drawn.

Harmon (1960) reported the results of anterior extraperitoneal interbody fusion in 250 patients.